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Examining Itraconazole Gel's Effectiveness in Treating Fungal Dermatological Condition

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Abstract: *Itraconazole is an antifungal medication commonly used to treat a variety of systemic and superficial fungal infections. While itraconazole is typically available in oral capsuleform, you can combine them to create a topical gel to treat fungal skin infections. This process involves extracting the active ingredientsfrom itraconazole capsules and incorporating them into a suitable gel base, such as a carbomer or hydroxyethyl cellulose -based formulation. The gel base is prepared by dissolving the active ingredient in an appropriate solvent, followed by careful mixing to ensure uniform distribution of itraconazole. Additional ingredients,such as preservatives and pH adjusters, may be added to enhance stability and self-life. The final gel formulation is packaged in airtight containers to protect it from degradation. Topical itraconazole gel provides a localized treatment for fungal infection on theskin, with the potential for improved drug delivery to affected areas. However, Healthcare practitioners should prescribe compounded itraconazole gels and assess their safety and effectiveness depending on patient-specific characteristics and the kind of infection.*

Keywords: itraconazole, topical gel, Carbopol 934p,method for topical drug delivery, Na CMC fungal infection

I. INTRODUCTION

These days, one of the most prevalent dermatological issues is fungal infection of the skin. One of the most prevalent conditions is superficial fungal infections of the skin. It has an impact on the epidermis, hair, and nails [1]. Worldwide, fungal infections of the skin, hair, and nails constitute a prevalent public health issue. According to a population-based survey, they are rarely managed. It is estimated that between 20 and 25 percent of people globally will get skin fungal infections, and their occurrence is rising [2, 3]. In South Korea, they account for 10–20% of all dermatology outpatients [4]. The use of immunosuppressive medications and antibiotics may be the cause of this rise [5]. The fungus could result in Human skin serves as a physical barrier, but occasionally fungi can infect it. If this happens on the third layer regarding the skin, the infection gets worse. To treat fungal infections, antifungal creams, liquids, or sprays based on azole derivatives are available; however, these formulations exhibit a range of adverse effects at the application site. Skin disorders can be brought on by bacteria, viruses, parasites, and fungi. Because they affect the third layer of the epidermis, fungal infections are more serious [6]. Subcutaneous skin infections are caused by fungi, and in recent years, the number of instances of fungal skin infections has been sharply rising, particularly in people with weakened immune systems [7]. Due to their ability to penetrate keratinized tissues and the stratum corneum, dermatophytes, including Trichophyton, Microsporum, and Epidermophyton, are the main culprits behind fungal infections of the skin [8, 9]. Trichophyton species are primarily responsible for a number of well-known severe skin illnesses (Table 1), including Tinea corporis (ringworm), Tinea pedis, Tinea faciei, Tinea manuum, Tinea cruris (joy-itch), and Tinea barbae [10, 11].

TABLE 1.1

Tinea infection	Affected location	Reference
Tinea capitis	Scalp	[12]
Tinea corporis	Trunk	[13]
Tinea faciei	Face	[14]
Tinea manuum	Hands	[15]
Tinea pedis	Feet	[16]

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Tinea unguium	Nails	[17]

Symptoms of fungal infections usually include hair loss, crusty spots, and itchy red patches [18]. Donning clothing that is too tight or sharing a locker room, clothes, or furniture with an infected person are two common situations that might result in a fungal infection [19]. Various fungal infections are treated using antifungal medications, mainly topical, oral, and intravenous; however, oral antifungal medications are more harmful to the human body than topical ones. Anywhere in the body, via topical routes like the skin, vagina, rectum, and eyes, topical medication administration is a technique for localized drug delivery. One of the organs in the human body that is easiest to apply topically, skin serves as the primary channel for topical medication delivery systems.

ROUTE OF PENETRATION:

Drug molecules interact with bacteria, cellular debris, and other substances at the skin's surface, which affects penetration. Hair follicles, sweat ducts, and the continuous stratum corneum between the appendages (hair follicles, sebaceous glands, eccrine, apocrine glands, and nails) are the three routes by which the applied medicinal ingredient enters the living tissue. Because it circumvents the first-pass impact, gastrointestinal distress, and metabolic breakdown linked to oral administration, this method of medication administration has grown in favor. Topical administration has been used to either induce systemic pharmacological effects or a local effect for treating skin disorders. [20, 21] The main goal of applying a medication in relation to the skin to treat skin diseases is to produce a local effect at the application location. Usually, only a little portion of the dosage really reaches the region of action. resulting in little local activity. Both systemic and cutaneous fungal infections are extremely frequent. Fungal infections can be treated with drugs applied locally or taken orally. Oral medication, however, has systemic adverse impacts as well as is not very effective in treating local fungal infections. Fluconazole, ketoconazole, clotrimazole, itraconazole, miconazole, and griseofulvin are among the drugs used to treat infections caused by fungi. Fluconazole, a synthetic antifungal medication that is a member of the imidazole class, prevents the growth of the fungus that causes infections. It is used to treat fungal infections.

Fungal infection:

A disquieting trend after the 1950s is the rising frequency of fungus infections because ofthe increasing use of broad-spectrum antibiotics, corticosteroids, anticancer/ immunosuppressants. Fungal infections are widespread in the population, typically connected to mucus and skin, emergence of AIDS, indwelling catheters, implants and dentures. They cause the host's defenses to weaken, making it easier for saprophytic fungus to infiltrate living tissue.22–24

Prevention:

Most fungal infections can be prevented by keeping skin clean and dry and keeping up basic hygiene.
Steer clear of sharing dirty clothes, sports equipment, and towels.
Keeping your skin dry and clean by wearing breathable clothing may also help prevent infections.
Basic hygiene can help treat and prevent ringworms as well
Safety in public includes wearing sandals into public showers or locker rooms and avoiding shared items and towels.

Risk factors for fungal skin infection:

Human fungal infections are widespread and, with prompt and appropriate treatment, are typically not very dangerous.
People with antibiotics and those with compromised immune systems may be more susceptible to fungal infections.
Diabetes and cancer treatment may also increase an individual's susceptibility to fungal infections.

Fungal skin infection treatment:

Dermatophytosis

With cure rates ranging from 80 to 90 percent, medical treatment of the majority of dermatophyte infections that affect the skin has produced outstanding results. As a result, a wide variety of antifungal drugs are currently available in topical and oral formulations [25, 26, 27, 28]. Creams, gels, and lotions with free antifungal agents are used to treat fungal infections of the skin [29]. Compared to oral antifungal medications, topically administered antifungal drugs have fewer harmful effects since they work locally [30]. In the case of topical formulations, which are more prevalent in oral antifungal drug molecules, the likelihood of medication-drug interactions is minimal [31]. However, erythema, burning, stinging, and skin redness are possible consequences of topical antifungal medication formulations such as

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creams, gels, and lotions [32]. The effectiveness of standard antifungal formulations against Fungal infections of the skin are diminished by their high dose frequency and poor skin penetration of hydrophilic antifungal medications [33]. Dermatophyte skin infections can be treated with a variety of topical treatments. Because of their low frequency of side effects, topical imidazole formulations, including clotrimazole, miconazole, econazole, and ketoconazole, are now commonly acknowledged as effective therapies for ringworm infections. Additional drugs in this class, such as tioconazole [34] and sulconazole, are also equally effective. Newer treatments like isoconazole,[35] luliconazole,[36] and sertaconazole[37] have joined these earlier topicals, however theynot yet received worldwide approval.

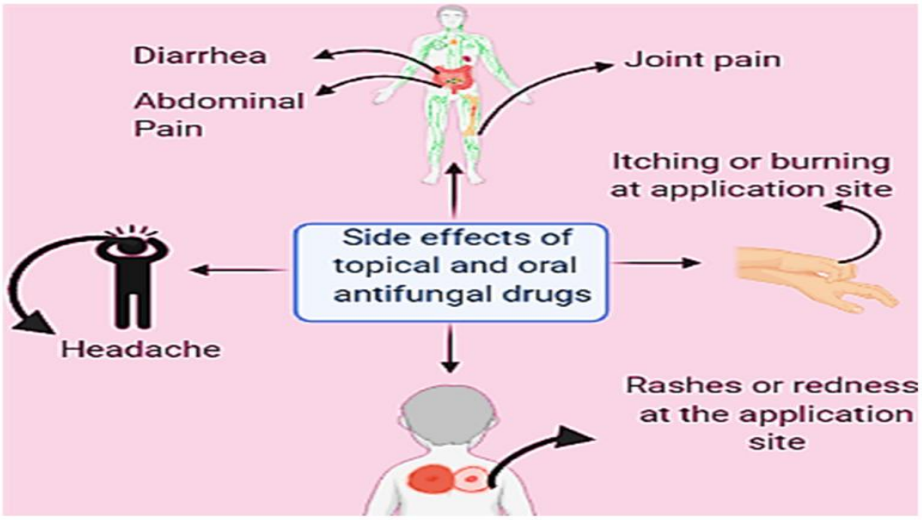

Figure 1: topical and oral anti-fungal side effect

Topical treatment

Numerous topical therapies have been used to treat dermatophyte skin infections [38,39,40,41,42]. This method rarely results in allergic or irritating contact dermatitis, nor does it frequently cause serious side effects. Clotrimazole, miconazole, econazole, and ketoconazole are examples of topical imidazole medicines that are typically offered in cream, solution, or spray form at a 1% concentration. With a low rate of side effects, these drugs are now widely recognized as efficient therapies for ringworm infections [43, 44]. While some, like bifonazole, are permitted for once-daily usage, Most are used for two to four weeks, twice a day [45]. The effectiveness of the various azoles varies very little [46]. After fairly brief application times, such as seven days, Certain dermatophyte infections, such as interdigital tinea pedis, remit when terbinafine cream is used topically in cases of dermatophytosis. Cycloprox is marketed topically in several countries to treat dermatophytosis [47].

TABLE 1.2 Classification of topical preparation

Class	Example
Liquid preparations	Liniment, lotions, paints, topical solution
Semi solid preparations	Creams, pastes, gels, ointments
Solid preparations	Topical Powders, poultices
Miscellaneous preparations	Topical aerosol, transdermal mechanism for delivering drugs, rubbing alcohols, tapes and gauze

Oral Antifungals Treatment

Skin infections caused by dermatophytes can be effectively treated with oral antifungals. Terbinafine is taken orally at a dosage of 250 mg daily to treat dermatophytosis. In dry-type tinea pedis, tinea cruris, and tinea corporis, it results in rapid and durable remissions after two weeks [48]. A 125 mg tablet is available for the treatment of children in several countries. Itraconazole is effective against a range of dermatophytes when administered in regimens of 100 mg for 30 days for dry type tinea pedis or 2 weeks for tinea cruris and corporis [49]. For dry type tinea pedis, it takes two weeks,

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while for tinea corporis, it takes one week. The currently recommended regimen is for 400 mg per day [50, 51]. Sometimes lengthier treatment durations are required. In certain areas, itraconazole is accessible in a novel formulation that is more frequently absorbed [52].For a period of two to four weeks, 50 mg of fluconazole is used daily to treat cutaneous dermatophyte infections [53]. Treatment for cruris or tinea corporis lasts two to four weeks.

Benefits of topical medication delivery:

- Avoidance of first pass metabolism.
- Convenient and easy to apply.
- avoiding the dangers and drawbacks of intravenous therapy in addition to the various conditions of absorption, such as pH fluctuations, the existence of enzymes, the time it takes for the stomach to empty, etc.
- prevents differences between and between patients in addition to changes in drug levels.
- the ease with which the Drugs may be stopped when necessary.
- a comparatively wide application area in contrast to the nasal or buccal cavities.
- the capacity to more precisely administer a medication to a certain location.
- avoiding incompatibility with the gastrointestinal system.
- Improving physiological and pharmacological response.
- Boost patient adherence.
- Provide suitability for self-medication. [54-56]

Antifungal agent and mechanism of action:

- **Azole derivatives:**acts on ergosterol's biosynthetic pathway resulting in membrane fluidity increase and accumulation of toxic sterol
- **Allylamines:**targets plasma membrane specifically on initial stages of ergosterol synthesis
- **Pyrimidine:** acts on nucleus, especially on DNA synthesis
- **Polyenes:** targets plasma membrane, and ergosterol specifically leading to membrane fluidity increase and cell death
- **Echinocandins:** targeting the fungal cell wall's B (1-3) glucan [57].

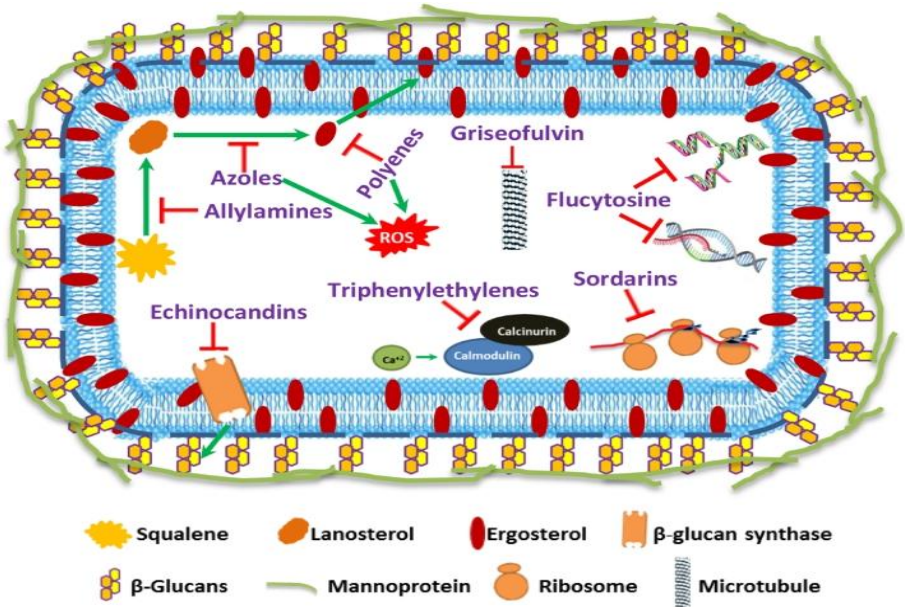

Figure 2: Mechanism of action of anti-fungal

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TABLE 1.3 An antifungal medication to treat dermatophytosis

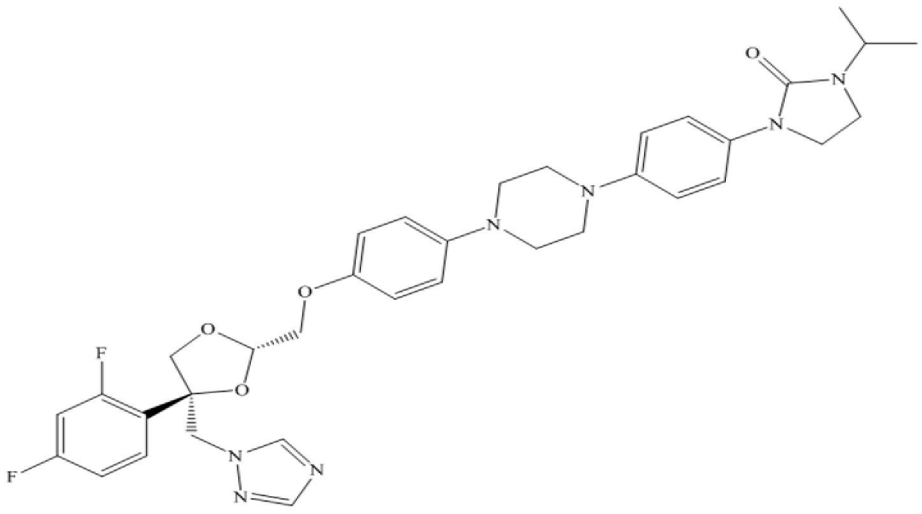
Class of drug	Example
Azole (imidazole and triazoles)	Clotrimazole, miconazole, econazole, ketoconazole, itraconazole, bifonazole, butoconazole, croconazole, eberconazole, econazole, fenticonazole, flutrimazole, isoconazole, omoconazole, oxiconazole, sertaconazole, sulconazole, terconazole, tioconazole.
Allylamines and Benzylamines	Terbinafine, Naftifine, Butenafine
Morpholine derivatives	Amorolfine
Miscellaneous	Griseofulvin

Itraconazole (triazole derivatives):

is broad-spectrum triazole antifungal medication that was initially prescribed in 1987 for those with invasive fungal infections. At that time, the only effective systemic treatment alternatives were fluconazole and amphotericin B, which was novel [58, 59]Itraconazole was initially used in clinical settings as a capsule containing pellets covered in sugar. Although this was quite effective in treating fungus-related skin and nail infections [60], it did not provide adequately dependable bioavailability in neutropenic patients, despite some initially positive results. Apart from treating infections, itraconazole can also be used to prevent these systemic fungal infections in people who are at risk. Certain patient groups that regularly receive prophylactic itraconazole

are individuals who have received Transplanting organs, are undergoing chemotherapy, or are HIV patients. Due to its low level of fungal resistance, safety profile, and broad-spectrum coverage, itraconazole provides these immunocompromised individuals with good prophylactic protection.[61].

Itraconazole From all these Triazole derivatives in this present journal about Itraconazole is discussed briefly. Itraconazole (ITZ) chemically 2-butan-2-yl-4-[4-[4-[[(2R,4S)-2-(2,4-dichlorophenyl)-2-(1,2,4-triazol-1- ylmethyl)-1,3-dioxolan-4-yl] methoxy] phenyl] piperazin-1-yl] phenyl]-1,2,4-triazol-3-one[62]



Itraconazole's mode of action:

A broad-spectrum Itraconazole is an antifungal medication that has an active metabolite called hydroxyitraconazole. Ergosterol synthesis is inhibited by itraconazole, this supports the fungal cell membrane's upkeep. Alpha-demethylase 14 in fungi catalyzes the 14 alpha-demethylation process that converts lanosterol to ergosterol. Through its interaction with the substrate-binding site of Itraconazole and fungal 14 alpha-demethylase inhibits this process. Fungal membrane irregularities brought on by this compromised ergosterol synthesis alter the activity of membrane-bound enzymes by increasing permeability and rupturing the integrity of fungal cell membranes.[63]

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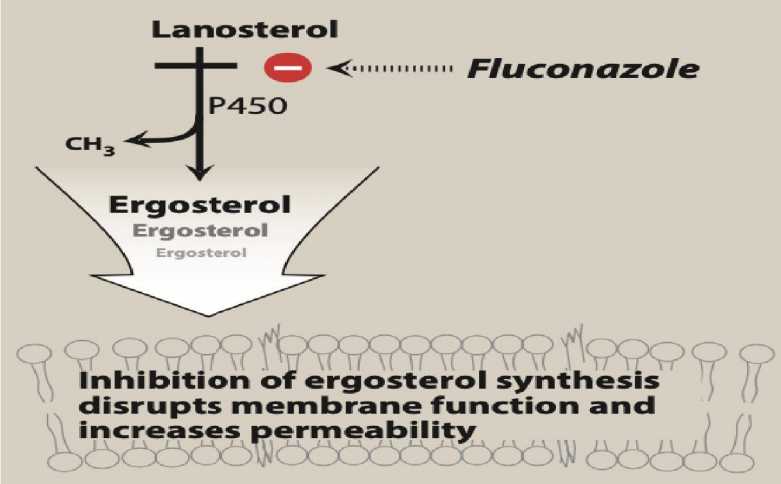

Figure: mechanism of action of itraconazole

Fungi's cell membranes contain ergosterol, a sterol that performs numerous identical tasks as human cholesterol. Ergosterol is an attractive target for antifungal medications because it is not found in the cells of animals. In recent years, the quantity of nosocomial and Fungal diseases throughout the body has increased, and with it, the quantity of cases that are resistant to treatment. Triazole antifungals have shown some of the best antifungal properties; thus, innovative treatments that can overcome this resistance are required. [64]

Adverse drug reaction:

Itraconazole, while being a reasonably safe drug, using it can have certain negative side effects. Cardiotoxicity is an uncommon side consequence. Itraconazole can lower the ejection fraction of the left ventricle and cardiac contractility.[65]

An intake greater than 400 mg per day raises the danger of cardiotoxicity. After stopping the itraconazole, most patients have an improvement in heart function; nonetheless, some need a transplant.[66]

Hepatotoxicity, which frequently appears as a reversible rise in aminotransferase levels, is another negative consequence. Short-term or sporadic doses can minimize this negative effect. Itraconazole can lead to resistant hypertension in people who are currently receiving treatment for hypertension.[67]

Gastrointestinal problems, including nausea, moderate diarrhea, vomiting, and stomach discomfort, are the most common side effects. Researchers found that between 2 and 39 percent of patients who had taken itraconazole experienced these side effects.[68]

Additionally, Injection site responses are possible, headaches, and rash when itraconazole is administered intravenously.

TABLE 1.4 Itraconazole's function in antifungal treatment plans

Clinical problem	Role of itraconazole	References
Keeping invasive fungal diseases at bay	The only antifungal medication with conclusive proof that it shields neutropenic individuals with hematological malignancies from Invasive fungal diseases, particularly those brought on by Aspergillus	[69,70]
Empirical antifungal therapy	Efficacy similar to that of conventional amphotericin B; much lower toxicity	[71,72]
Bioavailability	Available as an intravenous or oral solution (drug monitoring and loading dosage necessary)	[73,74,75,76]
Interaction between drugs	Co-administration with medications that are metabolized by cytochrome P450 3A4 should be avoided or modified for	

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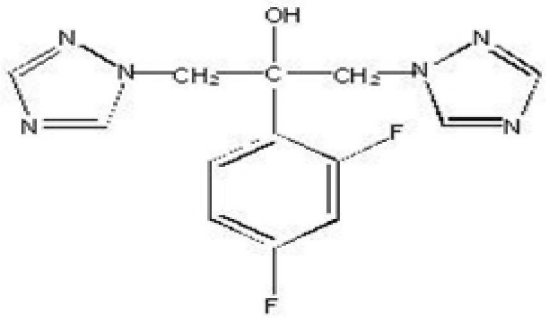
Fluconazole:

By interacting with the fungus cytochrome P450-dependent enzyme lanosterol 14-alpha demethylase, the triazole antifungal medication fluconazole selectively inhibits the conversion of lanosterol to ergosterol. Ergosterol makes up the majority between the fungal membrane and fluconazole enhances cellular permeability by blocking its formation. Additionally, it aids in the suppression of yeast growth and endogenous respiration. Fluconazole able to be given intravenously or orally to treat dermatophytosis and localized and spread mycoses. [77] Fluconazole isavailable commercially as oral and parenteral dosage forms which can beassociated withserious adverseeffects such as nausea, vomiting, bloating, diarrhea, rash, reduction in red blood cells, as well as abdominal discomfort. Compared to topical preparations, conventional forms have a lower bioavailability. Along with having a less localized effect but more side effects that must be managed, oral formulations necessitate high-dosage formulations, which may be costly and impractical. Additionally, they have altered gastrointestinal drug absorption due to gastrointestinal pH, enzymatic activity, and drug interactions with food and beverages [78,79]. Over 80% of fluconazole taken orally is in the bloodstream, with 60–70% of it being excreted in the urine. Only 10% of the drug is protein bound.



Fluconazole's actuation mechanism:

The cytochrome P-450 enzyme 14-demethylase, which facilitates lanosterol's transformation into ergosterol, interacts with fluconazole. Since ergosterol is an essential component of the fungal cell membrane, fluconazole increases cellular permeability by blocking its synthesis. Medicine also inhibits the production of yeasts and endogenous respiration. Notably, the primary cause of fluconazole's apparent fungistatic action is the loss of sterols, which occurs concurrently with the buildup of sterols in fungi.[80]

Topical itraconazole antifungal gel:

Among the greatest antifungal medications for fungal infections is itraconazole, which is used to treat fungal infections in both HIV-positive and non-HIV-positive people. In contrast to fluconazole and miconazole, it is extremely lipophilic or nearly insoluble in water [81]. Aspergillosis, blastomycosis, histoplasmosis, and fungal infections confined to the toenails and fingernails can all be effectively treated with itraconazole. Itraconazole is not fully absorbed from the gut [82,83].Solid dosage, semisolid dosage form, and liquid dosage formulation are some of the many therapy options available to doctors. Clear transparent gels are a popular topical formulation in both pharmaceuticals and cosmetics [84]. Clinicians and patients can choose from a broad range of vehicle preparations, including solids, semisolids, and liquids, for the topical therapy for dermatological diseases and skin care. Transparent gels have become more widely used in the primary category of semisolid preparations are pharmacological and cosmetic preparations. [85]. Drug distribution to patients utilizing a range of pharmaceutical dosage forms, such as tablets, capsules, pills, suppositories, cream, gel, ointments, liquids, aerosols, and injectables, has been the primary method of treating acute or chronic illnesses for many decades. Skin-based drug delivery is a targeted and successful treatment for localized dermatological conditions. Because it circumvents the first-pass effects, gastrointestinal distress, and metabolic breakdown linked to oral administration, this method of medication administration has grown in favor. Only 25–45% of the oral dosage

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enters the bloodstream because of the effect of the first pass. The gel formulations have been suggested as a topical remedy to get around these drawbacks. Gels are defined as "a semi-solid system where a liquid phase is contained within a polymeric matrix that has been highly cross-linked chemically and physically."[86]

Dosage forms that are accessible:

Tablets

Capsule.

However, this antifungal agent's gel dose was not developed.

Thetopical therapy for superficial fungal infections involves a range of dose forms, including creams, liquids, gels, ointments, lacquers, and others. Creams, liquids, gels, and ointments are readily available for the treatment of ringworm and athlete's foot.

Classification of gels:

A. Gels can be grouped according to their physical attributes, rheological characteristics, solvent type, and colloidal phases.[87]

B. Based on colloidal phase

In a two-phase system (inorganic): the dispersed phase's particle size is comparatively large, and the gel creates a three-dimensional structure. They must be thixotropic, forming semisolids when left alone and turning liquid when stirred.

Single-phase system (organic): Large organic molecules dispersed in a continuous phase on twisted strands make up single-phase gels. These bigger organic molecules moved evenly throughout a liquid so that There were none obvious separations between it and the liquid.

Based on the type of solvent being used:

Water-based hydrogels: Water functions as a continuous liquid phase in hydrogels. For instance, carpooler, gelatin, cellulose derivatives, bentonite magma, and poloxamer gel.

The continuous phase of Using a non-aqueous solvent, organic gels:contains a non-aqueous solvent. For instance, metallic stearate dispersion in oils and plastic bases (low molecular weight polyethylene dissolved in mineral oil and short-cooled) Oleg (aerosol) gel.

Xerogels: Solid gels with a reduced solvent concentration are represented by xerogels. They are created when the solvent dissipates, and the gel framework comes into touch with new fluid. For instance, polystyrene, dry cellulose, acacia tear β-cyclodextrin, and tragacanth ribbons.

According to rheological characteristics: gels typically show non-Newtonian flow. They fall under the following categories:

Plastic gel - The rheogram plot indicates the gels' yield value, at which the elastic gel deforms and starts to flow. Aluminum hydroxide flocculated suspensions, such as Bingham bodies, show a plastic flow.

Gel made of fake plastic – This kind of gel, such as liquid dispersions of sodium alginate with tragacanth, Na CMC, etc., has a drop in viscosity and an increase in shear rate without any yield value.

Shows flow that is pseudoplastic.

Thixotropic gels: Particle connections in this kind of gel are extremely weak and are shatter able by shaking. The particles will collide and relink, causing the resultant solution—such as kaolin, bentonite, and agar—to gel (the reversible isothermal gel-sol-gel transformation).

According to physical nature:

Elastic gels: At the junction, relatively weak interactions like dipole attraction and hydrogen bonding hold the fibrous molecules together. For instance, alginates, guar gum, and agar gels.

Gels that are rigid: These are examples of gel macromolecules where a principal valence bond holds the framework together. For instance, the Si-O-Si-O bonds that hold silica acid molecules together in silica gel create a network of pores in a polymer material.

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Bases or gel forming polymers

It can be classified as follows:

Natural polymers: those that occur naturally and can be produced by living things. Examples of these include polysaccharides like agar, tragacanth, pectin, and gum, in addition to proteins like collagen, gelatin, and others.

semi-synthetic polymers -The majority Among these polymers are created by biochemically modifying natural polymers. e.g. cellulose derivatives likecarboxymethylcellulose, methylcellulose, hydroxyethyl cellulose.

synthetic polymers- The polymers which are prepared under in-vitro conditions are called synthetic polymers. E.g. carbomer Carbopol 940, Carbopol 934, poloxamer, polyacrylamide, polyvinyl alcohol, and polyethylene.

Inorganic substances – Aluminum hydroxide and Benitoite.

Surfactants – sebrotearyl alcohol and Brij

Materials and techniques:

Itraconazole, carbopol934, triethanolamine, glycerin, Methylparaben, propylparaben, water.

Table 1.5 List of materials used

S.N.	Ingredients	Intended For Use
1	Itraconazole	Active pharmaceutical ingredient
2	Carbopol 940	Preparation of gel base
3	Na CMC	Preparation of gel base
4	Glycerin	Moistening agent
5	Triethanolamine	Buffer
6	Methyl paraben sodium	Preservatives
7	Propyl paraben sodium	Preservatives
8	Alcohol (methanol)	Diluent /penetration enhancer

Table 1.6 list of equipment used

S. N	Equipment	Specifications
1	Electron balance	excell, model BH
2	UV spectrophotometer	UV spectrophotometer
3	Mechanical stirrer	DICA, India
4	PH meter	HANNA instrument
5	Hot air oven	SHIV, India

Method of preparation:

Using varying polymer concentrations, six itraconazole topical gel formulations (F1–F6) were created. A beaker was filled with filtered water, Carbopol 940, and Na CMC in varying quantities, and the mixture was left to soak for twenty-four hours. Carbopol 940 was neutralized with an adequate amount of triethanolamine after the necessary amount of medication had been dissolved in water. Alcohol (methanol) was employed as a penetration booster and glycerin as a moisturizing agent. Preservatives propyl and methyl paraben sodium were added gradually while being constantly stirred to create a uniform gel.

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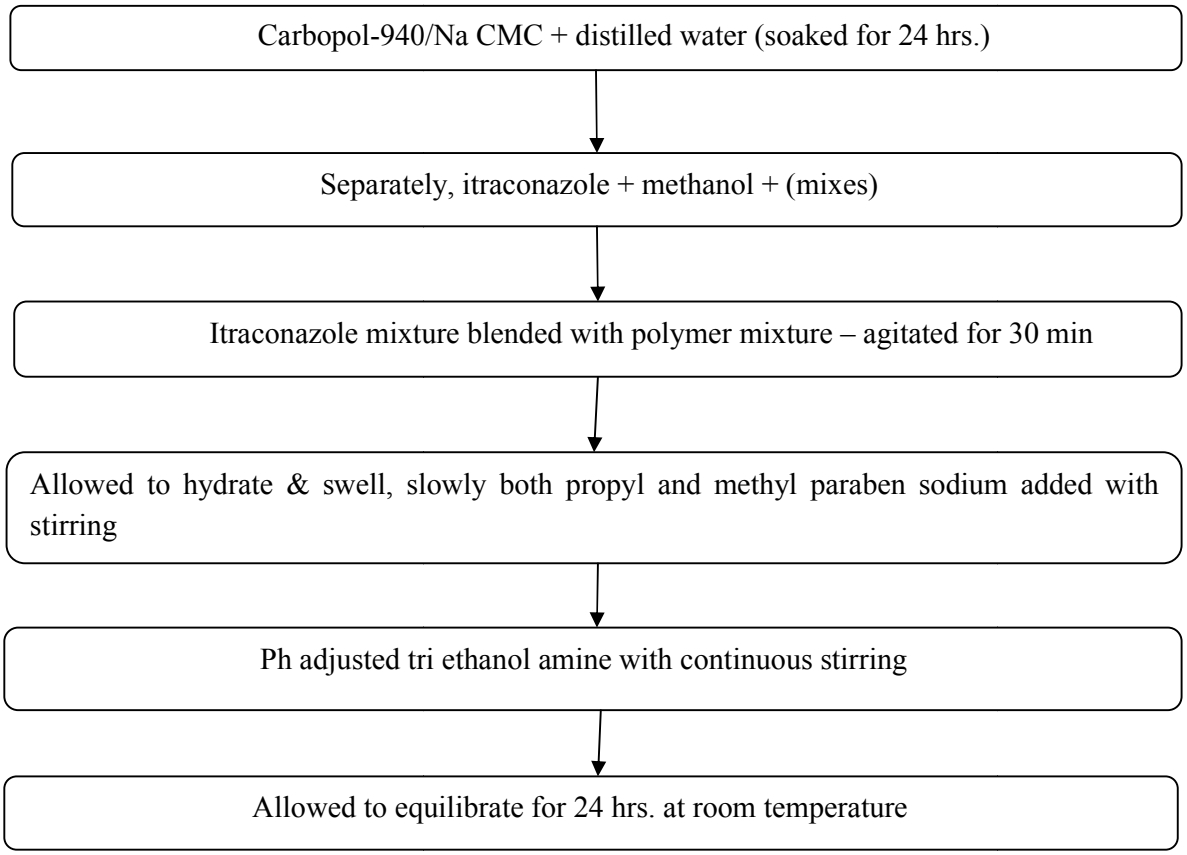
Itraconazole gel development process flow chart:



Physiochemical Evaluation of Prepared itraconazoleGels:

Percentage Yield:

Weighing's were taken of the empty container, the container holding the gel formulation, and the gel formulation itself. The practical yield is then obtained by subtracting the empty container's weight from the container containing the gel formulation. The formula was then used to get the yield percentage.

$$\text{Percentage yield} = \frac{\text{Practical yield}}{\text{Theoretical yield}} \times 100$$

Drug content:

Ten grams of each gel formulation were weighed, then put into a 250 ml flask with a volumetric with 20 ml of alcohol and swirled for half an hour. The sound level was filtered after being increased to 100 milliliters. Ten milliliters of alcohol were used to dilute one milliliter of the solution, and then ten milliliters of alcohol were used again. Using spectrophotometry, the solution's absorbance was determined at 260 nm. The drug content was calculated using the following formula.

$$\text{Drug content} = \frac{\text{Absorbance}}{\text{Slope}} \times \text{Dilution factor} \times \frac{1}{1000}$$

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Determination of Ph:

Each gel formulation weighed 50 grams, which were then placed into 10 milliliters of the breaker and tested with an electronic pH meter. To treat skin infections, the topical gel formulation's pH ought should be between 3 and 9.

Spreadability:

By calculating one gram's diameter of gel between horizontal plates (20×20 cm^2) after one minute, the gel formulation's spread ability was ascertained. A standard weight of 125 grams was fastened to the upper plate.

Extrudability:

The gel composition were filled into a collapsible metal tube or aluminum collapsible tube. The tube was pressed to extrude the material, and the formulation's extrudability was examined.

Viscosity estimation:

A Brookfield viscometer DVII model with A helipath stand and a T-Bar spindle were utilized to gauge the gel's viscosity.

Spindle selection: The amount of viscosity in each gel was measured using T 95 spindle.

Size of an example container: A 100 ml beaker containing 50 g of gel was employed to quantify viscosity.

Immersion of the spindle: In the center, the T-bar spindle (T95) was lowered perpendicularly. being careful not to contact the jar's bottom.

Viscosity measurement: The gels' viscosity was assessed using the T95, or T-bar spindle. Throughout the procedure, the variables that impact viscosity, like sample size, pressure, and temperature, were kept constant. Viscosities were obtained at several locations along the route by moving the helipath T-bar spindle up and down. Every time, the torque value was higher than 10%. The gels' viscosity was measured by averaging three measurements within a minute.

II. CONCLUSION

The results from these tests provide valuable insights into the performance and quality of the gel formulation. A formulation that yields the desired drug content, has the correct pH, good spread ability, and extrudability, along with optimal viscosity, indicates that the gel is likely to be effective, safe, and user-friendly. These attributes are essential for ensuring that the gel performs well in its intended application for treating skin conditions.

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